CROTON HYDROELECTRIC PLANT, POWERHOUSE
Croton Dam Road, at the Muskegon River
Croton vicinity
Newaygo County
Michigan

HAER No. MI-81-B

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
Philadelphia Support Office
U.S. Custom House
200 Chestnut Street
Philadelphia, P.A. 19106

HISTORIC AMERICAN ENGINEERING RECORD

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HAER No. MI-81-B

Location:	Croton Dam Road, at the Muskegon River, Croton Vicinity, Newaygo County, Michigan UTM: 16.608140.4810000 Quad: Croton, MI, 1:24,000
Dates of Construction:	1906-1908, 1915
Engineer:	William G. Fargo
Present Owner:	Consumers Power Company, 212 West Michigan Avenue, Jackson, Michigan 49201
Present Use:	Powerhouse for hydroelectric generating plant
Significance:	The Croton Hydroelectric Plant powerhouse was designed by William G. Fargo, a Jackson, Michigan civil engineer who specialized in the design of small and mid-sized hydroelectric plants in the Midwest in the early Twentieth Century. This building housed the turbines, generators, and transformers used to produce record-setting high voltage transmission of electrical power in 1908.
Project Information:	This documentation is the result of a May 9, 1994 consultation meeting between the Consumers Power Company (CPCo) and the State Historic Preservation Office (SHPO). This meeting took place in response to CPCo's desire to rehabilitate the plant's spillway. As a result of the meeting, CPCo and the SHPO agreed to the recordation of the entire Croton Hydroelectric plant in accordance with Historic American Engineering guidelines. The documentation was completed in 1994 by Dr. Charles K. Hyde, Wayne State University, under contract to CPCo.

HISTORY

Drawings of the south elevation of the Powerhouse as late as 6 November 1906 show the Generator Building with only a single set of six round openings for transmission lines situated well below the tympanum and on the same level as the window sills of the Turbine Building. Beneath the six round openings were a row of six rectangular windows, a concrete belt course, and finally, at the base-of the building, three extremely tall rectangular windows flanked on each side by a single rectangular window perhaps two-thirds as tall. The current window configuration on the south elevation of the Generator Building first appears in a drawing dated 24 July 1907. These alterations were necessary because of changes in the arrangement of equipment inside the Generator Building.[1]

When the Generator Building first went into operation, the south end of the building housed three transformers to step-up the voltage produced by the generators to the pressure used in transmission, along with a total of twelve 66,000-volt oil switches. The round transformers, each 8 feet 3 inches in diameter, were arranged in a single row at the southern end of the building, 11 feet 3 inches center to center. The southwest corner of the building housed a tank holding oil which was pumped into the transformers for cooling through a system of 4 inch pipes. This cylindrical oil tank measured 6 feet in diameter and 13 feet high.

The south end of the building had two elevated galleries, each 9 feet 5 inches wide and 44 feet long and each housed six oil switches, each 6 feet deep, 5 feet 10 inches wide, and 10 feet high. The twelve circular openings in the south facade of the Generator Building, each 2 feet in diameter, encased the high voltage transmission lines extending outside of the building. This transformer and switching equipment was removed in 1930, when a separate Substation went into service to the west of the spillway.[2]

When two new generators were installed in the Turbine Building in 1915, a small addition was made to the southeast end of the building, including the addition of a new gable end, which precisely reproduced the design of the original 1908 gable ends with respect to materials, the size and configuration of windows, and the placement of decorative elements.[3]

PHYSICAL DESCRIPTION

The Croton Powerhouse consists of two adjoining buildings: the Generator Building on the west and the Turbine Building to the east. The buildings connect at the northeast corner of the Generator Building. The overall layout of the Powerhouse is asymmetrical. The southern end of the Generator Building, for example, projects out further than the Turbine Building; and the center gable of the Turbine Building intersects the building at the southeast corner, thereby giving the structure an off-centered appearance.

The powerhouse rests on a reinforced concrete foundation, which in turn rests on approximately 3,000 round oak timber piles. All exterior walls rest on sheet steel pilings which act as cutoffs to prevent water from undermining the foundations. The powerhouse is 60 feet in height, with two gabled roofs supported by steel Warren trusses, each 46 feet 10 inches long at the base, extending 26 feet 3 inches along the inclined surface. Eleven roof trusses were used to support the Turbine Building roof and nine for the Generator Building. The easternmost wing, the Turbine Building, was originally 47 feet wide and 100 feet long, but a small addition 10 feet wide and 50 feet long was made to the southeast corner of the Turbine Building in 1915, when two new generators were installed. The addition is perpendicular to the original building and produces a second gable end on the south facade. The westernmost wing of the powerhouse, the Generator Building, is 46.83 feet wide and 82.50 feet long and is perpendicular to the Turbine Building.

Two reinforced concrete retaining walls extend 40 feet upstream from the northeast and northwest corners of the Generator Building to form a triangle which serves as an anchor for a floating trash boom which keeps refuse out of the turbine pits. A similar triangle is formed by two reinforced concrete retaining walls extending 50 feet south from the downstream (south) facade of the Generator Building. A concrete training wall extends an additional 140 feet south from the tip of this triangle.

PHYSICAL DESCRIPTION (continued)

The major facades, which are located on the gable ends, have a distinctly symmetrical appearance, which is created by the placement of windows around a central vertical axis that intersects the apex of the gable. On the southern facade of the Generator Building, two rows of circular concrete plugs (which at one time were openings for high-voltage transmission cables) also are oriented around the same axis.

Both the Generator and Turbine buildings are single-story buildings with vastly different interior spaces. The lower two-thirds of the Turbine Building is occupied by a pair of vertical turbines and two pair of Francis horizontal turbines, so the floor level is only about fifteen feet below the bottom of the roof trussing. In contrast, the floor of the Generator Building is at the base of the building proper. From the outside, however, the Generator Building does not appear so cavernous because horizontal lines on the gable ends seem to indicate the existence of distinct stories: one and a half or two stories on most elevations, with an additional one on the southern elevation. The uppermost level is formed by the pediment of the gable. Stylistic brickwork reinforces the recessed and triangular lines of each tympanum. Belt courses of brick or concrete mark further horizontal divisions on the gable end facades.

Exterior facades are sheathed in red brick. Concrete is used in all window sills, transmission line plugs, and for two of the belt courses on the southern facade of the Generator Building. A massive concrete casing cloaks most of the southern facade of the Turbine Building. Cornices, overhangs, finials, and downspouts are made of galvanized iron. Steel entrance doors are located on the north and east ends of the Generator Building and the east end of the Turbine Building.

PHYSICAL DESCRIPTION (continued)

Fenestration occurs only on the gable ends. Windows vary in length. Some appear singly, others in groups of two or three. The most architecturally distinctive windows (consisting of three Palladia-like rounded-arch windows) are located in the tympana. The gabled roofs of the Powerhouse have a modest slope of thirty degrees. Tile originally covered the roofs, which are now covered by asphalt shingles. Each gable end has a parapet with galvanized-iron parapet coping. A finial stands at the apex of each gable. The other roof edges slide into overhanging cornices which convey water from the roof into downspouts. The Generator Building also has a roof monitor (3 feet 6 inches high and 5 feet 6 inches wide) which extends the entire length of the building. The monitor is fitted with windows along its entire length, originally installed to provide light and ventilation. The windows are now covered and are mostly inoperable.

The extant equipment in the Generator Building includes the two original Westinghouse horizontal generators, each rated at 3,750 K.V.A., 7,500 Volts, 289 Amps, operating at 225 R.P.M. These three phase, 60-cycle units are each driven by a pair of Allis-Chalmers quadriplex horizontal turbines with 44-inch Francis runners set in pairs, installed in 1915. Each pair of turbines is rated at 4,000 Horsepower when operated at 225 R.P.M. with a hydraulic head of 39.00 feet. The water feed for each set of turbines is controlled by electrically-driven hydraulic governors, manufactured by Allis-Chalmers of Milwaukee, Wisconsin. The generators have direct-connected exciters. The generators were originally operated at 6,600 volts and the line voltage was stepped up to 100,000 volts with three delta-connected transformers of 3,000 kilowatts capacity. When the generator voltage was increased to 7,200 in early 1909, the result was approximately 110,000 volts on the high side of the transformers.

PHYSICAL DESCRIPTION (continued)

The Generator Building also houses a large rectangular electrical control panel, with a metal cover painted black and equipped with General Electric meters. The control panel proper was built by Condit Electrical Manufacturing Company of South Boston, Massachusetts. In addition, there is a small passenger elevator in the northeast corner of the building.

The east end of the Turbine Building includes a pair of vertical generators and the turbines which drive them, all installed in 1915. The turbines are 57 inch Francis type hydraulic turbines and are direct-connected to the generators, each with a 33 KW direct-connected exciter. The generators are Allis-Chalmers units, one rated at 1,610 K.V.A. and the other at 1,400 K.V.A., both producing 7,500 volts of 60 cycle, three-phase current. Both are driven by Allis-Chalmers vertical turbines, each rated at 1,730 Brake Horsepower when operated at 150 R.P.M. and utilizing a hydraulic head of 39.00 feet. The east end of the building also houses a pair of electrically-driven hydraulic governors to control water flow to the turbines, also manufactured by Allis-Chalmers, but not installed until sometime after 1920.

NOTES

[1]"Down Stream Elevation," Plans for Dam and Power Plant on the Muskegon River at Croton, Mich. for the Grand Rapids- Muskegon Power Co., Grand Rapids, Mich., William G. Fargo, Civil Engineer, Jackson, Mich., Sheet No. 1141 (10-18-'06, revised 11-6-'06) and "Down Stream Elevation" Sheet No. 1223B (7-24-'07).

[2]"Piping and Wiring Plans, Croton Dam, Grand Rapids-Muskegon Power Co., Grand Rapids, Mich., Sheet No. 1133 (9-27-'06, revised 11-2-'06) and "Revised Plan, Oil Switch Gallery," Sheet No. 1223 (2-14-'07), Sheet No. 1223-A (2-20-'07), and Sheet No. 1223-B (3-12-'07, revised 4-4-'07).

[3]"Plans Showing Changes in Penstocks," Croton Dam on the Muskegon River at Croton, Mich. for the Eastern Michigan Power Company, Jackson, Mich., Fargo Engineering Company, Jackson, Mich., Sheet No. 3618 (5-21-1915, revised 6-6-1915).

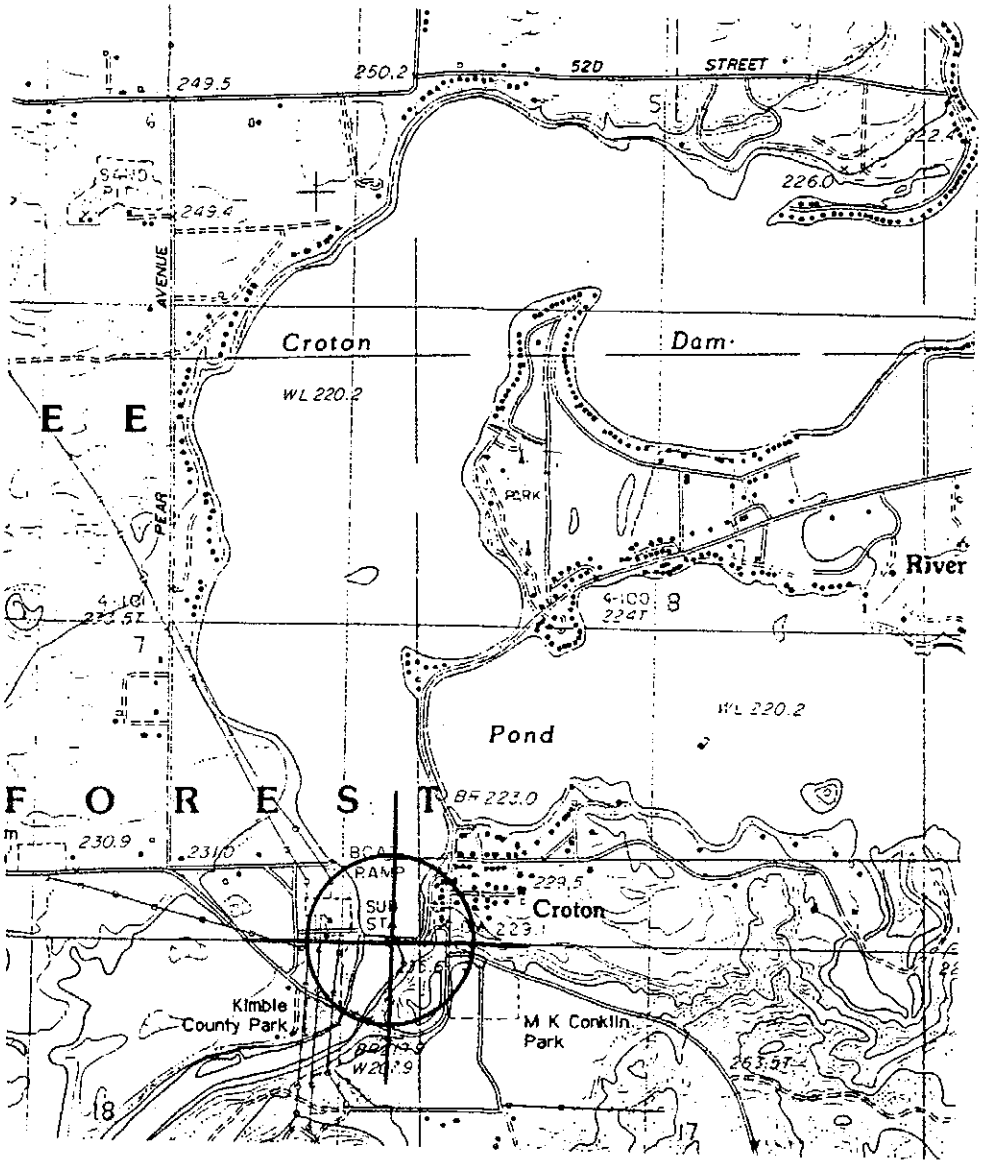
SOURCES OF INFORMATION

A. Engineering Drawings: The Consumers Power Company Engineering Department, 1945 West Parnall, Jackson, MI 49201, has over one hundred sheets of drawings produced by Fargo Engineering between 1906 and 1920. This collection of drawings is likely to be preserved well into the future.

B. Historic Views: Four historic views are in the office building at the Croton Hydroelectric Plant.

CROTON, MICHIGAN QUADRANGLE, 1:24,000

UTM: 16.608140.4810000



FLOOR PLANS OF POWERHOUSE